

of liquid air it is at once cooled so intensely that all the moisture it contains is precipitated as frost on the sides of the vessel. Whatever gaseous moisture is left in the air at this low temperature is entirely inappreciable to our methods of measurement. This air may, therefore, be considered practically dry and may be passed on into other vessels for such experiments as our correspondent has in mind.

The different tensions of ice vapor and water vapor are explained in an important memoir by Prof. M. Thiesen, of Berlin, which we hope to publish for the information of our readers.

TEMPERATURE AND MOISTURE OF SOILS IN RED RIVER VALLEY.

In the October report of the North Dakota Section, Mr. B. H. Bronson publishes the first part of an excellent paper entitled *Some Studies in Meteorology*, by Prof. E. F. Ladd of the Agricultural College at Fargo, N. Dak. Professor Ladd says that he proposes to publish the results of the continuous observations made at that place since August, 1891. His first study relates to the question of earth temperatures, the depth of the frost, and the quantity of moisture offered to the growing wheat by the thawing of the soil when the rainfall is small and even deficient, upon which matters misconceptions seem to have arisen.

The temperatures of the soil have been determined by means of thermometers at eight different depths, viz, 1, 3, 6, 12, 24, 48, 60, and 84 inches. The instruments were of the pattern designed by Dr. Sturtevant for use at the New York State Experiment Station. In only one winter, that of 1895, did the frost line reach down 5 feet, but each year it passed below 4 feet. The frost was all out of the ground by the 20th of May each year, with a possible exception of 1892-93. It is evident, therefore, that the gradual thawing of the frozen ground, during the summer months can not be a source of moisture to supply the growing crop of wheat. The fact is that the soils of the Red River Valley have the power of holding large quantities of water in storage.

The mean temperature of the soil at different depths, as observed daily at midday for seven years, 1892-1898, is shown in the following table:

Months.	Depth of thermometer, in inches.							
	1.	3.	6.	12.	24.	48.	60.	84.
May	56.6	50.8	46.8	43.9	38.7	34.3	33.7	34.8
June	67.0	61.9	58.8	57.6	51.0	44.0	40.9	38.0
July	74.1	67.9	65.2	63.6	59.3	53.1	49.1	43.7
August	75.6	66.2	64.5	63.5	61.0	56.0	52.9	47.4

THE WEATHER OF THE MONTH.

By ALFRED J. HENRY, Chief of Division of Meteorological Records.

The chief characteristics of the month were high temperatures, relatively heavy rains for the season, light winds, and an absence of severe local or general storms.

Cloudiness was generally greater than usual and the relative humidity of the air was in excess of the normal in the majority of districts.

PRESSURE.

The distribution of monthly mean pressure, shown by Chart IV, differs in several important particulars from the normal distribution for October. The most important departure from normal conditions was the apparent shifting of the area of high pressure usually found over Georgia and South Carolina, to the Middle Atlantic and New England States. It will also be noticed that the monthly means over the last-named region average about 30.20 inches, which value is greater than the local normal October pressures, and also greater by a tenth of an inch than the normal October pressure over the south Atlantic States.

The configuration of the monthly mean isobars follows a summer type more closely than an autumnal one, and is typical of a wet rather than a dry month in the interior valleys and generally to the westward. In a dry October the monthly mean isobars generally run east and west, and the two dominating highs are frequently joined in a ridge of high pressure extending from the Georgia coast to the Plateau region.

TEMPERATURE OF THE AIR.

The distribution of monthly mean surface temperature, as deduced from the records of about 1,000 stations, is shown on Chart VI.

East of the one hundredth meridian the temperature was above normal by amounts ranging from 6° and 8°, daily, in the middle Mississippi Valley, to less than a degree on the Atlantic coast. West of the above-mentioned meridian temperature was below normal by amounts ranging from 4° in eastern Oregon to less than a degree on the Pacific coast.

A period of abnormally high temperature in the central and eastern portions of the country set in about the 10th and continued until about the 25th. During this period unusually high temperatures were recorded in the Mississippi and Missouri valleys, the Lake region, and eastward to New England.

The lines of freezing temperatures did not extend so far south as in the corresponding month of 1898, and in general the minimum temperatures were not so low as in that year, while the maximum temperatures were higher.

Average temperatures and departures from the normal.

Districts.	Number of stations.	Average temperatures for the current month.	Departures for the current month.	Accumulated departures since January 1.	Average departures since January 1.
New England	10	52.8	+ 1.9	+ 2.2	+ 0.2
Middle Atlantic	12	58.3	+ 2.5	+ 0.7	+ 0.1
South Atlantic	10	66.0	+ 1.9	+ 2.0	+ 0.2
Florida Peninsula	7	65.1	+ 1.4	+ 3.5	+ 0.4
East Gulf	7	69.3	+ 2.5	+ 1.7	+ 0.2
West Gulf	7	70.9	+ 3.8	+ 1.6	+ 0.2
Ohio Valley and Tennessee	12	61.6	+ 4.9	+ 4.3	+ 0.4
Lower Lake	8	56.2	+ 4.9	+ 6.4	+ 0.6
Upper Lake	9	51.9	+ 5.0	+ 1.0	+ 0.1
North Dakota	7	43.4	+ 0.8	-18.6	- 1.9
Upper Mississippi	11	58.8	+ 6.1	+ 1.0	+ 0.1
Missouri Valley	10	57.9	+ 5.2	+ 4.0	+ 0.4
Northern Slope	7	44.4	+ 1.8	-25.0	- 2.5
Middle Slope	6	58.8	+ 3.6	+ 3.2	+ 0.3
Southern Slope	6	65.8	+ 4.1	+ 4.7	+ 0.5
Southern Plateau	13	57.9	+ 1.6	+ 6.5	+ 0.6
Middle Plateau	9	46.8	+ 3.2	-14.3	- 1.4
Northern Plateau	10	45.7	+ 3.2	-16.9	- 1.7
North Pacific	9	51.1	+ 0.8	-12.4	- 1.2
Middle Pacific	5	58.2	+ 1.3	+ 4.9	+ 0.5
South Pacific	4	61.5	+ 1.9	+ 5.5	+ 0.6

In Canada.—Prof. R. F. Stupart says:

The mean temperature of the month differed little from normal on Vancouver Island and the lower mainland of British Columbia, but on the upper mainland it ranged from 2° to 5° below. In Alberta and the western portions of Assiniboia and Saskatchewan it was about 4° below average, but east of this, near the western boundary of Manitoba, the departure from average became plus, and eastern Manitoba was from 3° to 4° above. All the remaining inhabited portions of Canada were also above, the greatest departures being from 5° to 6° in western and southern Ontario. At nearly all points in the Maritime Provinces the difference from normal was about 2°.

PRECIPITATION.

Precipitation was above normal in the majority of States and districts for the first time in many months. The rains on the Pacific coast were abundant and fairly well distributed, and the general outlook from an agricultural standpoint is very much improved.

There was an abundance of rain for the season in western and southwestern Texas, Oklahoma, western Kansas, northern Wisconsin, and elsewhere.

The most notable deficits occurred over a strip of country extending northeastward from the mouth of the Mississippi River to New England, the continuity of which was broken only in Tennessee, where the rains were seasonable.

SNOWFALL.

The snowfall of the month was confined principally to the upper Missouri Valley and the Rocky Mountain and Plateau regions. The snowfall on the Sierra Nevada at the crossing of the Central Pacific in California ranged from 2 to 3 feet. No snow fell in the Great Valley of California or along the immediate California coast. A very severe snowstorm occurred in western Montana, directly along the eastern foot hills, and extending from Augusta to the international boundary line. The storm was unexpectedly severe, and a number of sheep herders, probably as many as twelve, lost their lives before a place of shelter could be reached. The storm-swept area was about 20 miles wide and upward of 100 miles long. The depth of snowfall over this strip was from 30 to 40 inches, but on either side the amount was very much less.

The depth of snowfall during the month is graphically shown on Chart VIII, and the numerical values are given in Table II.

Average precipitation and departures from the normal.

Districts.	Number of stations.	Average.		Departure.	
		Current month.	Percentage of normal.	Current month.	Accumulated since Jan. 1.
		<i>Inches.</i>		<i>Inches.</i>	<i>Inches.</i>
New England	10	2.26	56	-1.8	-3.6
Middle Atlantic	12	2.50	76	-0.8	-2.3
South Atlantic	10	4.90	120	+0.8	-4.6
Florida Peninsula	7	7.91	161	+3.0	0.0
East Gulf	7	1.83	65	-1.0	-10.6
West Gulf	7	3.39	132	+0.6	-7.9
Ohio Valley and Tennessee	12	2.13	81	-0.5	-4.6
Lower Lake	8	2.23	71	-0.9	-6.0
Upper Lake	9	2.45	83	-0.5	-2.8
North Dakota	7	1.28	93	-0.1	-2.0
Upper Mississippi Valley	11	2.23	88	-0.3	+0.1
Missouri Valley	10	1.87	100	0.0	-5.1
Northern Slope	7	1.15	153	+0.4	-0.3
Middle Slope	6	2.83	213	+1.5	+2.9
Southern Slope	6	2.70	159	+1.0	+3.2
Southern Plateau	13	0.50	56	-0.4	-2.5
Middle Plateau	9	2.02	246	+1.2	+1.9
Northern Plateau	10	2.09	192	+1.0	+0.1
North Pacific	9	6.54	127	+1.4	+4.9
Middle Pacific	5	3.92	258	+2.4	+0.3
South Pacific	4	1.97	294	+1.3	-0.5

In Canada.—Professor Stupart says:

The conditions as regards precipitation, were not abnormal to any marked degree in any part of the Dominion. From the limited number of British Columbia reports yet received, it would appear that the average was somewhat exceeded in that Province; and in the North-

west Territories and Manitoba the total, while comparatively small in most localities, was yet in excess of the average, and in the Territories fell largely as snow. At Qu'Appelle, the station reporting the largest amount, it was wholly snow, and 24 inches fell between the 10th and 14th. In the Peninsula of Ontario, that is over the portion of the Province lying west of a line connecting Parry Sound and Belleville, the rainfall was considerably above average, and at some stations near Lakes Ontario and Erie nearly double the average, but in the more eastern and northern parts of the Province there was a deficiency, the rainfall averaging in the neighborhood of 2 inches. In Quebec and New Brunswick there was a very general deficiency, Montreal being the only station reporting an amount slightly greater than the average. In Nova Scotia and Prince Edward Island the fall was for the most part either equal to or in excess of the normal.

HAIL.

The following are the dates on which hail fell in the respective States:

Arizona, 11, 12. Colorado, 2, 3. Georgia, 19. Idaho, 11, Illinois, 14, 19. Indiana, 19, 27. Iowa, 11, 13, 14. Kansas, 14. Louisiana, 21. Michigan, 15, 22. Minnesota, 5, 14, 15, 24. Missouri, 19. Nebraska, 14, 15, 24. New Mexico, 2. North Carolina, 24, 29. Oregon, 10, 11, 12, 19, 24. Tennessee, 19. Texas, 19, 20, 31. Washington, 1, 10, 16, 19. Wisconsin, 14. Wyoming, 10, 14, 16.

SLEET.

The following are the dates on which sleet fell in the respective States:

Colorado, 9, 10, 12, 13, 16, 25, 31. Idaho, 14. Maine, 2. Michigan, 22. Minnesota, 16, 17. Montana, 9, 12, 20, 21, 22. New Hampshire, 20, 21. New Mexico, 31. North Dakota, 11, 12, 15, 16. Ohio, 22. Oregon, 12, 18. South Dakota, 14, 15. Vermont, 2. Wyoming, 14.

HUMIDITY.*Average relative humidity and departures from the normal.*

Districts.	Average.	Departure from the normal.	Districts.	Average.	Departure from the normal.
New England	80	+	Missouri Valley	63	+1
Middle Atlantic	80	+	Northern Slope	63	+10
South Atlantic	82	+	Middle Slope	63	0
Florida Peninsula	80	+	Southern Slope	63	0
East Gulf	74	+	Southern Plateau	63	-10
West Gulf	72	+	Middle Plateau	43	+
Ohio Valley and Tennessee	70	+	Northern Plateau	67	+
Lower Lake	75	+	North Pacific Coast	67	+
Upper Lake	80	+	Middle Pacific Coast	67	+
North Dakota	78	+	South Pacific Coast	70	+1
Upper Mississippi	70	+			

WIND.

The maximum wind velocity at each Weather Bureau station for a period of five minutes is given in Table I, which also gives the altitude of Weather Bureau anemometers above ground.

Following are the velocities of 50 miles and over per hour registered during the month:

Maximum wind velocities.

Stations.	Date.	Velocity.	Direction.	Stations.	Date.	Velocity.	Direction.
Block Island, R. I.	6	53	ne.	Havana, Cuba	24	51	ne.
Do.	31	57	ne.	Mount Tamalpais, Cal.	9	54	nw.
Cape Henry, Va.	6	58	nw.	Do.	10	71	nw.
Do.	80	66	ne.	Do.	18	50	nw.
Do.	31	72	ne.	Do.	19	61	se.
Charleston, S. C.	30	58	nw.	Do.	23	52	nw.
Chicago, Ill.	10	53	s.	New York, N. Y.	31	52	ne.
Fort Canby, Wash.	18	76	se.	Norfolk, Va.	31	50	ne.
Do.	19	78	se.				

SUNSHINE AND CLOUDINESS.

The distribution of sunshine is graphically shown on Chart VII, and the numerical values of average daylight cloudiness, both for individual stations and by geographical districts, appear in Table I.

Average cloudiness and departures from the normal.

Districts.	Average.	Departure from the normal.	Districts.	Average.	Departure from the normal.
New England	6.4	+0.9	Missouri Valley	4.0	+0.1
Middle Atlantic	5.0	+0.2	Northern Slope	5.5	+1.3
South Atlantic	5.1	+1.1	Middle Slope	3.6	+0.5
Florida Peninsula	5.5	+0.8	Southern Slope	2.9	+0.1
East Gulf	4.4	+0.8	Southern Plateau	2.5	+0.5
West Gulf	4.3	+0.7	Middle Plateau	4.9	+1.7
Ohio Valley and Tennessee ..	4.5	0.0	Northern Plateau	6.3	+1.2
Lower Lake	5.1	-0.7	North Pacific Coast	6.7	+0.8
Upper Lake	6.0	-0.1	Middle Pacific Coast	4.2	+1.0
North Dakota	6.0	+0.9	South Pacific Coast	3.5	+0.5
Upper Mississippi	4.2	-0.2			

ATMOSPHERIC ELECTRICITY.

Numerical statistics relative to auroras and thunderstorms are given in Table VII, which shows the number of stations from which meteorological reports were received, and the number of such stations reporting thunderstorms (T) and

auroras (A) in each State and on each day of the month, respectively.

Thunderstorms.—Reports of 732 thunderstorms were received during the current month as against 619 in 1898 and 2,203 during the preceding month.

The dates on which the number of reports of thunderstorms for the whole country were most numerous were: 19th, 87; 15th, 80; 14th, 69; 24th, 65.

Reports were most numerous from: Minnesota, 71; Michigan, 68; Iowa, 60; Wisconsin, 56; Nebraska, 55.

Auroras.—The evenings on which bright moonlight must have interfered with observations of faint auroras are assumed to be the four preceding and following the date of full moon, viz, 14th to 22d.

The greatest number of reports were received for the following dates: 5th, 18; 6th, 22, and 23d, 3.

Reports were most numerous from: Montana, 8; North Dakota, 5; Minnesota, 4.

In Canada.—Auroras were reported as follows: Yarmouth, 5th, 22d; Father Point, 14th, 23d, 26th; Quebec, 5th, 14th, 15th; Toronto, 5th; White River, 26th; Minnedosa, 25th; Qu'Appelle, 5th, 6th, 7th; Swift Current, 30th; Prince Albert, 4th, 5th, 6th, 30th.

Thunderstorms were reported as follows: Father Point, 24th; Toronto, 14th, 23d; White River, 24th; Ottawa, 14th; Port Stanley, 22d, 23d; Saugeen, 14th, 23d; Parry Sound, 14th, 23d; Port Arthur, 13th; Calgary, 6th.

DESCRIPTION OF TABLES AND CHARTS.

By ALFRED J. HENRY, Chief of Division of Meteorological Records.

For description of tables and charts see page 424 of REVIEW for September, 1899.